Activity Title: Scallop Data Analysis

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Subject (Focus/Topic): Biology, Ecology, Marine Biology
Grade Level: High School
Average Learning Time: About 1 week or 5 50 minute class periods
Lesson Summary (Overview/Purpose): During this data analysis activity, students will create an inquiry question, study the data collected by the scientists of NOAA's scallop survey that addresses their question and form their own conclusions around what factors impact their population.

Essential Question: What factors affect the population of *Placopectin magellanicus*?

Background Information

The North Atlantic Deep Sea Scallop is one of the most important fisheries in the Northeast United States, bringing in about 450 million dollars annually! It is essential that this economic resource is harvested responsibly so that their populations are sustainable. NOAA's annual sea scallop dredge survey carefully monitors the scallop populations, sampling areas as far south as Virginia and as far north as Georges Bank into Canadian waters NOAA's responsibility is to take an accurate inventory of the scallops, their size and age. Based on their sizes and ages NOAA scientists can use computer models to make predictions for the future of the population in an area. This information can get passed on to a regional council that then makes recommendations/regulations for the scallop fishing industry. These regulations are around the minimum size of the catch, the number of boats, the number of crew members on the boat and the number of days that fishing is permitted. During this data analysis activity, you will study the data collected by the scientists of NOAA's scallop survey and form your own conclusions around what factors impact their population.

Standards:

- **National/State Science Education Standard(s) Addressed:**
    - S:LS2:11:1.5 , Using data from a specific ecosystem, explain relationships or make predictions about how environmental disturbance (human impact or natural events) affects the flow of energy or cycling of matter in an ecosystem.

- **Ocean Literacy Principles Addressed:**
    - The ocean supports a great diversity of life and ecosystems.
        - Ocean biology provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
        - Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate, and circulation ocean life is not evenly distributed temporally or spatially, i.e. it is "patchy." Some regions of the ocean support

more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.

- The ocean is largely unexplored.
    - Use of mathematical models is now an essential part of ocean sciences. Models help us to understand the complexity of the ocean and of its interaction with Earth's climate. They process observations and help describe the interactions among systems.
- The oceans and humans are inextricably interconnected.
    - From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
    - Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution and physical modifications. In addition, humans have removed most of the large vertebrates from the ocean.

Goals:
During this activity students will:

- Gain an understanding of how fisheries are managed
- Have an opportunity to work with real data and for students to understand how that data was collected
- Graph and analyze data support their conclusions

Keywords: fishery, linear regression, r value, independent and dependent variables

Materials: Powerpoint slide show, data sets, computers with Excel and word processing

Technical Requirements: Have data sets on a class website available so that it is ready for students to manipulate

Day One (50 minute class period)

- Pre-assessment:
- Begin class by asking students, "Who likes to eat scallops?"
- Background information on scallops, show students a video of scallops swimming, and the scallop fishery-including open and closed areas
- Slide show showing sampling techniques used onboard the *R/V Hugh R. Sharp (*students will take notes so they can incorporate the information into their scientific paper) and show students a map of the sampling location
- Brainstorm as a class, which factors would have an impact on scallops?
- Have students decide on their own scientific question to investigate and write question in journal

Forming a Scientific Question
Students will design their own inquiry question using the following guidelines to ensure that they will have the data necessary to analyze. Students will get to select the independent and dependent variable to study.

Example Question: Does _____ affect _____ in *Placopectin magellanicus*?
A B

Possible Independent Variables	Possible Dependent Variables
Geographic location Sea star population count Species diversity Crab population size Open or closed fishing area Depth Temperature	Population size Size of individuals

Day One Homework:

- Do some preliminary research on the factor you chose. Summarize your research with citation information in your journal—this is will be a rough draft of their introduction for their scientific paper.
- State your hypothesis. What do you expect to see in the data? How will your factor impact the scallops? Be sure to support your hypothesis with your research notes.

Day Two (double block, 100 minutes)

- In groups of 4, students share the results of their homework assignment (share their results and hypothesis)
- Predicting: have students draw a picture of what they think their graph will look like based on their hypothesis in their journal
- Show students where to access the data that addresses their question
- Have students graph their data using excel, labeling the axis and giving their graph a title

Day Two Homework:

- Write a rough draft of your conclusion

Day Three (50 minute class period)

- Group students according to their inquiry questions
- In these small groups, students will discuss their data and their conclusions
- After small group work, peer edit conclusions—checking for the use of data

SMALL GROUP DATA DEBRIEFS

Goals for small group conversations--to collaborate, share ideas and observations and to help each other make connections between your research and your data.

In small groups discuss the following prompts:

1. Compare your graph with others in your group. Do they look similar? They should! If your graph looks different--then someone has some trouble with their data.
2. What impact do you think your factor is having on scallops? What data points support this conclusion?
4. What unusual data points did you pick out? How did you explain these points?
5. Share your predictions for the future of scallops.
6. What recommendations would you make for scallop fishery regulatory council?
*write down notes and ideas that come up in your discussion so you can add those ideas to your conclusion.

DAY Three Homework:

- Write the final draft of your scientific paper

Day Four (50 minutes)

- Class discussion
    - What suggestions/recommendations would you make for the council that regulates the scallop fishery? Use evidence from the data you analyzed to support your statements
    - What did you learn about how fisheries are managed?
- Turn in final drafts of scallop scientific paper

Guidelines for Scallop Scientific Paper

Title

At the top of your paper, include an original, creative, short title. It should reflect the content of your paper.

Introduction

- State your scientific question. What were you trying to find out? What was the purpose?
- What is your hypothesis and what are the reasons for your prediction?
- Provide background information on scallops. Be sure to include the following:
    - Scientific name in the proper format
    - Life history information for the species
    - Describe its habitat
    - Describe the scallop fishery
- You must include outside information that you have researched about the specific topic – you must cite all of the sources that you use in this research. You will most likely need to do **in-text citation** as well as a **work cited page** of all sources – please use MLA format

Data

- Provide a table with your raw data
- Provide your titled excel graph of your data
- What is the location, date and source for your data?
- Provide the equation for your best fit line and the r value

Conclusion

- This is where you must interpret your data. You should explain what your data means and if it supports with your hypothesis. To guide this work, your conclusion should address the following prompts:
    - Describe the impact (if any) your factor is having on scallops. Is it a big or small impact? Is there a relationship between your factor and the scallops? Why or why not? Do you think there could be other factors that are having a larger impact on their populations?

        - What predictions for the future of sea scallop populations could you make based on your analysis?
        - **Implications:** What recommendations would you make to a regional council for regulations on the scallop fishery based on your data?
- Be sure to use your data to support your conclusions. You should have actual **numbers** in your conclusion. Also you must refer to your graph by its title. Example: "As you can see in *Figure 1: The Population Size of Deep Sea Scallops at Various Depths*…"
- You must cite all of the sources that you use in this research. You will most likely need to do **in-text citation** as well as a **work cited page** of all sources – please use MLA format
- **Honor's Challenge/Exceeding Expectations**: What lingering questions do you have about sea scallops and factors that affect their populations? What would you need to do answer your questions? What data would you need to collect and how would you collect it?

Scallop Data Analysis Scientific Paper Rubric

	Effective Communicator	Complex Thinker
Exceeds Expectations= WOW Fulfills 'meets expectations' items + rises to exceed expectations in these ways:	❖ Captures and holds an audience's attention throughout the work ❖ Presentation/work is suitable for an audience beyond the Souhegan community and could be shared with the NOAA science team that collected the data	❖ Conclusions are independently drawn ❖ Synthesizes information ❖ Asks questions that lead to deeper inquiry about your populations ❖ Successfully applies concepts beyond obvious applications ❖ Crafts an original perspective
Meets Expectations	❖ The hypothesis is the focus of the work and is supported by preliminary research ❖ The introduction forecasts the content of the work and provides reader with sufficient background information on the species. ❖ Provides sufficient support and detail in both the introduction and conclusion using the data collected (you should have numbers in your conclusion and refer to your graph by name) ❖ Applies standards, conventions, and rules of a scientific paper (ex/ follows the proper lab report format, has an appropriate title, graphs are titles and axises are labeled, data is used to support conclusion) ❖ Work demonstrates appropriate use of source material.	❖ Conclusions are drawn with minimal teacher guidance ❖ Can accurately analyze data and is beginning to show synthesis of ideas ❖ Applies prior knowledge and research to new situations/problems ❖ Shows comfort with ambiguity (you are able to form conclusions even if your data doesn't show you what you expected)
Approaches Expectations	❖ Communication of main idea is unclear/off topic. ❖ The introduction and/or conclusion needs revision. ❖ Work would benefit from more support/detail ❖ More attention needed to standards, conventions, and rules of a scientific paper	❖ Significant teacher guidance needed in order to draw conclusions ❖ Difficulty transferring prior knowledge and research to new situations/tasks ❖ Shows discomfort with ambiguity
Does Not Meet Expectations	❖ Does not express thoughts clearly. ❖ Language may be awkward and offer little variety ❖ Work may depend too heavily on source material	❖ Inaccurate/Incomplete conclusions are drawn even with teacher guidance ❖ Difficulty initiating any steps to begin the task ❖ Does not demonstrate the use of prior knowledge or research